

Telecommunications Act of 1996 and Infrastructure Investment: Empirical Evidence

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Does TA96 unbundling reduce ILEC incentives to invest?

Investment Deterrence Hypothesis

- TA96 unbundling reduces ILEC investment.
- Denies ILEC opportunity for fair return on investment.
- Encourages CLEC “free-riding” on ILEC infrastructure.

Competitive Stimulus Hypothesis

- TA96 & unbundling enable & foster CLEC competition.
- Competition drives innovation, lowers prices, and expands markets.
- ILEC *and* CLEC investment increases.

Key Issue -- Since TA96 Unbundling So Important to Competition

- Local facilities still largely natural monopolies.
- ILECs still protected by substantial entry barriers
- Cable still far from competitive in telephony and business broadband DBS also.
- So unbundling only way to foster competition in services that utilize local plant, and in subsequent facilities deployment.
- Access to UNEs at TELRIC-based prices could be salient force for movements to competitively efficient pricing, along with competitively neutral measures for public purposes.

United States Telecom Association, et al.

v.

*Federal Communications Commission and United States of
America*

“There are plainly two sides to the effects on investment of ubiquitously available UNEs at Commission-mandated prices. . . . The question is how such investment compares with what would have occurred in the absence of the prospect of unbundling, . . . , an issue on which the record appears silent. Although we can’t expect the Commission to offer a precise assessment of disincentive effects (a lack of multiple regression analyses is not ipso facto arbitrary and capricious) we can expect at least some confrontation of the issue and some effort to make reasonable trade-offs. . . .”

Economic Logic Supports the Competitive Stimulus Hypothesis Over the Investment Deterrence Hypothesis

- Under TELRIC principles, UNE rates give ILECs adequate incentives to invest since they cover risks and economic depreciation.
- CLECs paying such compensatory UNE rates are not “free-riders” whose anticipation deters investment by the ILECs.
- ILECs will continue to invest so long as additional revenue brought in by incremental investment exceeds the cost of that incremental investment.

- UNEs can allow a CLEC to overcome entry barriers to build a customer base and then transition to its own facilities.
- CLECs have strong reasons to invest in their own facilities to avoid dependence on their rival ILECs once they have the scale.
- Such competitive threats give ILECs added incentive to improve their networks in order to avoid losing customers to new entrants.

Principal Empirical Questions

- What is the relationship between pricing of UNEs and investment in network infrastructure by ILECs?
 - Investment Deterrence Hypothesis: Positive
 - High UNE prices discourage utilization by CLECs.
 - Less utilization by CLECs encourages ILEC investment.
 - Competitive Stimulus Hypothesis: Negative
 - High UNE prices discourage entry by CLECs.
 - Reduced competition attenuates ILEC incentives to invest.
- **ANSWER: The estimated relationship is negative.**

More Principal Empirical Questions

- Do the data support the mechanism of the competitive stimulus hypothesis? That is,
 - Do lower UNE prices encourage greater CLEC activity?
 - Does greater CLEC activity encourage greater ILEC investment?
- **ANSWERS: YES & YES**
 - **Together these answers mean lower UNE prices encourage greater ILEC investment.**

Reduced Form Equation

$$\begin{aligned}
 \text{ILEC} \\
 \text{Investment} &= R \left(\begin{array}{ll} \text{Demand} & \text{Current} \\ \text{Factors}' & \text{Revenue} \end{array} \right. \\
 &\quad \left. \begin{array}{lll} \text{Ilec Cost of} & \text{Clec Cost of} & \text{Regulatory} \\ \text{Investment}' & \text{Participation}' & \text{Regime} \end{array} \right)
 \end{aligned}$$

Structural Form Equations

$$\begin{aligned}
 & \text{ILEC} \\
 & \text{Investment} = f \left(\begin{array}{l} \text{Demand} \quad \text{Current} \\ \text{Factors} \quad \text{Revenue} \\ \text{Ilec Cost of} \quad \text{Regulatory} \quad \text{CLEC} \\ \text{Investment} \quad \text{Regime} \quad \text{Activity} \end{array} \right)
 \end{aligned}$$

$$\begin{aligned}
 & \text{CLEC} \\
 & \text{Activity} = g \left(\begin{array}{l} \text{Demand} \quad \text{Current} \quad \text{CLEC Cost} \\ \text{Factors} \quad \text{Revenue} \quad \text{of Participation} \end{array} \right)
 \end{aligned}$$

Data

- Investment Data
 - ILECs: FCC ARMIS reporting system
 - State by state
 - Largest ILECs (BOCs)
 - CLECs: Generally not available
 - Many CLECs privately held.
 - Many are part of larger entities, and investment in telecom network infrastructure is not consistently reported in sufficiently disaggregated form.
- Measures of CLEC activity are available
 - Number of firms active by state.
 - Counts of Zip Codes within states with CLEC service.

Data (Continued)

- ILEC cost of investment: TELRIC cost for UNE-P by state
 - Available from FCC Synthesis Cost Model
- Net TPIS per capita in 1996
 - ARMIS data
- Average Revenue
 - per line by state
 - Estimated by AT&T from state tariffs, TNS Telecoms Harvesting Study, and ARMIS data. (As of June 2002)
- Other Demand Factors:
 - % Labor Force in FIRE in 2000 (from Census)
 - Growth in population 1990-2000 (from Census)
 - Average Unemployment 96-00 (from BLS)

Data (Continued)

- TSR Discount
 - Provided by AT&T. Average TSR discount in effect as of June 2002.
- Regulatory Regime
 - National Regulatory Research Institute Report (2000) form of regulation by state.
 - Rate of Return (*omitted*)
 - Price Cap Regulation
 - Price Cap/Interim Rate Freeze
 - Rate Freeze Non-indexed caps
 - Deregulation

Estimating ILEC Reduced Form

- **ILEC investment exhibits negative and statistically significant relationship with AT&T and FCC UNE prices.**
 - Reduced form relationship accounts for over 77% of state to state variation in ILEC investment.
 - ILEC investment increases with Population Growth and Average Revenue.
 - ILEC investment decreases with Deregulation (Relative to Rate of Return Regulation) and TELRIC.
- Results are consistent using earliest and latest vintage UNE Price data.
- **Supports Competitive Stimulus Hypothesis.**

ILEC INVESTMENT EQUATION
Reduced Form
Ordinary Least Squares Estimation

Description	Coefficient (Standard Error)	Coefficient (Standard Error)	Coefficient (Standard Error)	Coefficient (Standard Error)
<i>Dependent Variable is ILEC Investment to:</i>	2000	2001	2000	2001
<i>Source of UNE Price Data:</i>	AT&T, 6/02	AT&T, 6/02	FCC Proxy	FCC Proxy
<i>Independent Variables</i>				
Net Plant In Service per Capita 1996	0.0057 (0.0406)	0.0425 (0.0519)	0.0008 (0.0373)	0.0370 (0.0480)
Labor Force Share in FIRE 00	828.3316 * (360.0491)	899.0359 (460.0504)	536.2622 (327.8726)	496.1526 (421.8040)
Population Growth	173.6273 ** (42.5286)	226.8131 ** (54.3407)	160.6356 ** (39.1611)	209.3809 ** (50.3803)
Average Unemployment	-3.6339 (4.9357)	-10.3304 (6.3066)	-8.3200 (4.8133)	-16.4299 * (6.1923)
Average Revenue	4.7494 ** (1.6005)	6.6225 ** (2.0450)	4.0324 ** (1.3197)	5.4970 ** (1.6977)
Telric	-3.2538 ** (1.0938)	-4.1276 ** (1.3976)	-1.5589 (1.1781)	-1.9406 (1.5156)
Total Service Rebate	85.0554 (122.6383)	55.7267 (156.7003)	10.4192 (114.5614)	-43.5209 (147.3819)
UNE Price	-2.7628 * (1.0284)	-3.9071 ** (1.3141)	-6.7514 ** (1.7466)	-9.0386 ** (2.2470)
Price Cap	8.5180 (15.7405)	-3.1070 (20.1123)	15.4288 (13.9538)	7.0097 (17.9514)
Price Cap w/ Interim Freeze	12.6439 (16.2334)	1.3444 (20.7422)	13.6675 (14.4098)	3.8965 (18.5380)
Freeze w/ non-Index Cap	10.2213 (18.4754)	5.8072 (23.6068)	15.9930 (17.0972)	13.1563 (21.9954)
Deregulation	-136.9659 ** (35.0057)	-193.5255 ** (44.7283)	-127.3602 ** (31.2164)	-178.7707 ** (40.1596)
Constant	-93.7193 (62.4007)	-75.1956 (79.7321)	6.6464 (60.8792)	60.4753 (78.3203)
<i>Summary Statistics</i>				
Number of Observations	47	47	47	47
F Statistic	9.63 **	9.65 **	11.97 **	11.79 **
R ²	0.7727	0.7730	0.8085	0.8062
Adjusted R ²	0.6924	0.6929	0.7410	0.7378

** Statistically Significant at 99% confidence.

* Statistically Significant at 95% confidence.

Estimating ILEC Structural Form

- **ILEC investment exhibits positive and statistically significant relationship with CLEC activity.**
 - If CLEC Activity = log of Number of CLECs, statistically significant at 95% confidence.
 - If CLEC Activity = share of Zip Codes, statistically significant at 94% confidence.
 - Supports Competitive Stimulus Hypothesis.
- ILEC investment is increasing in Population Growth & Average Revenue
- ILEC investment is declining in Telric & Deregulation
- Structural Form Relationship accounts for nearly 75% of variation in ILEC investment.

EXHIBIT 3
ILEC INVESTMENT EQUATION
Structural Form
Ordinary Least Squares Estimation

Description	Coefficient (Standard Error)	Coefficient (Standard Error)	Coefficient (Standard Error)	Coefficient (Standard Error)
<i>Dependent Variable is ILEC Investment to</i>	2000	2001	2000	2001
<i>Independent Variables</i>				
Net Plant In Service per Capita 1996	0.0276 (0.0414)	0.0713 (0.0553)	-0.0184 (0.0437)	0.0208 (0.0581)
Log Number of CLECS	18.8408 * (7.0876)	20.5623 * (9.4595)		
Share of Zips w/ CLEC			36.3356 * (15.0629)	38.9008 (20.0364)
Labor Force Share in FIRE 00	580.0321 (452.1155)	537.1570 (603.4192)	839.2693 * (366.4533)	857.7838 (487.4477)
Population Growth	145.7465 ** (43.1725)	200.1888 ** (57.6205)	148.8528 ** (42.4301)	202.7094 ** (56.4395)
Average Unemployment	-3.2208 (4.9694)	-9.3215 (6.6325)	-2.8676 (4.9593)	-8.8375 (6.5968)
Average Revenue	3.1938 * (1.4340)	4.3023 * (1.9139)	3.3015 * (1.4296)	4.3609 * (1.9016)
Telric	-3.0351 * (1.2438)	-4.2664 * (1.6600)	-3.8339 ** (1.0481)	-5.0796 ** (1.3942)
Price Cap	10.7653 (15.4803)	1.7870 (20.6609)	16.4501 (15.0420)	8.2745 (20.0085)
Price Cap w/ Interim Freeze	15.1499 (15.9013)	7.9534 (21.2228)	20.7308 (15.3626)	14.2341 (20.4350)
Freeze w/ non-Index Cap	10.5574 (18.4382)	4.0174 (24.6087)	-0.6175 (18.6518)	-8.3251 (24.8101)
Deregulation	-114.3483 ** (33.0995)	-163.3171 ** (44.1765)	-116.9780 ** (33.3594)	-165.7673 ** (44.3738)
Constant	-114.2408 (63.6166)	-96.6967 (84.9063)	-91.7973 (58.2960)	-74.4393 (77.5440)
<i>Summary Statistics</i>				
Number of Observations	46	46	47	47
F Statistic	9.99 **	8.98 **	10.09 **	9.09 **
R ²	0.7637	0.7438	0.7603	0.7406
Adjusted R ²	0.6872	0.6610	0.6850	0.6591

** Statistically Significant at 99% confidence.

Simultaneity in the ILEC Structural Form

- ILEC Structural form is estimated using OLS regression.
 - System is recursive.
 - If correctly specified, then no simultaneity bias.
- Estimation with Simultaneity Bias in OLS Estimation.
 - If OLS estimates are affected by simultaneity bias, then should employ instrumental variables for CLEC activity.
 - Instruments are exogenous variables from CLEC activity equation.
 - Otherwise, OLS estimation is preferred.

Estimating CLEC Structural Form

- **CLEC activity exhibits negative and statistically significant relationship with AT&T and FCC UNE prices.**
 - 99% confidence level in 3 cases, 95% confidence level in one case.
 - Consistent results whether CLEC activity is measured by number of CLECs or share of zip codes.
 - Results are consistent using earliest and latest vintage UNE Price data.
- Supports Competitive Stimulus Hypothesis.

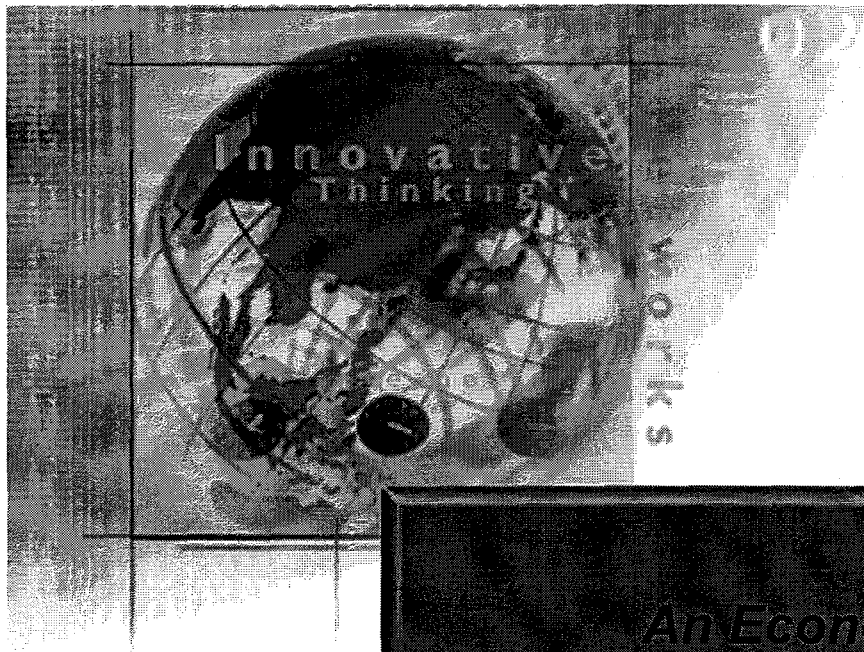
CLEC ACTIVITY EQUATION
Structural Form
Ordinary Least Squares Estimation

Description	Coefficient (Standard Error)	Coefficient (Standard Error)	Coefficient (Standard Error)	Coefficient (Standard Error)
<i>Dependent Variable</i>	Log Number CLECS	Share Zips w/ CLEC	Log Number CLECS	Share Zips w/ CLEC
<i>Source of UNE Price Data:</i>	AT&T, 6/02	AT&T, 6/02	FCC Proxy	FCC Proxy
<i>Independent Variables</i>				
Share of Labor in FIRE 00	12.1646 (7.8484)	1.1145 (2.7665)	0.3921 (8.3081)	-2.6517 (2.7967)
Population Growth	0.7718 (1.0275)	0.6427 (0.4193)	0.5775 (0.9376)	0.5834 (0.3788)
Average Unemployment	0.0268 (0.1125)	0.0284 (0.0473)	-0.0629 (0.1072)	-0.0019 (0.0442)
Average Revenue	-0.0148 (0.0342)	0.0050 (0.0140)	-0.0248 (0.0295)	0.0036 (0.0119)
UNE Price	-0.0651 ** (0.0219)	-0.0196 * (0.0089)	-0.1312 ** (0.0329)	-0.0470 ** (0.0130)
Total Service Rebate	5.0942 (2.9362)	2.7056 * (1.2381)	3.5143 (2.8072)	2.0118 (1.1668)
Constant	1.2564 (1.3981)	-0.0242 (0.5865)	4.0786 * (1.5204)	0.9797 (0.6138)
<i>Summary Statistics</i>				
Number of Observations	46	47	46	47
F Statistic	5.54 **	2.62 *	7.31 **	4.31 **
R ²	0.4599	0.2820	0.5293	0.3929
Adjusted R ²	0.3768	0.1743	0.4569	0.3019

** Statistically Significant at 99% confidence.

* Statistically Significant at 95% confidence

- The Competitive Stimulus Hypothesis
 - Is consistent with economic theory.
 - Competition promotes investment, and
 - UNEs promote competition.
 - Is supported by data.
 - Spares regulators and policy makers from having to evaluate trade-offs between social benefits of competition and social benefits from investment.



An Economic Analysis of Impairment

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The Economically Appropriate "Impairment" Standard

There is general agreement that impairment can be caused by:

- *Economies of Scale and Scope With Sunk Costs*
 - For network elements characterized by significant scale and/or scope economies, new entrants will be at a substantial cost disadvantage when competing with incumbent providers
 - Sunk costs make competitive entry significantly risky because they cannot be recouped if the necessary demand does not materialize or cannot be retained, e.g., facilities infrastructure costs, or if prices are driven down due to a glut of capacity
- *First Mover Advantages/Second Mover Disadvantages*
 - Benefits that the incumbent gained from being the first to market or disadvantages of a new incumbent because it is a subsequent entrant, e.g., ROW and building access issues
- *Other Entry Barriers*
 - Other non-transitory cost or practical impediments that preclude a new entrant from competing effectively against the incumbent, e.g., additional costs the incumbent does not face, such as "backhaul" costs



The Central Economic Issues Are Not In Dispute

- The ILECs have abandoned the “essential facilities” test and now acknowledge “the mere presence of a single competitive facility in a particular market [does not] necessarily preclude a finding of impairment in that market” *[SBC Reply at 10]*.
- The ILECs acknowledge that competitive carriers are “impaired” without access to facilities that are merely “expensive to duplicate,” not “economically infeasible” to duplicate *[SBC Reply at 9]*
- The ILECs also agree on the critical importance of sunk cost barriers. “[W]here sunk costs are very large relative to ongoing costs, an unregulated incumbent might be able to charge a significantly supracompetitive price without attracting entry” *[Qwest, Farrell Reply Dec. ¶ 13]*
- The ILECs also do not dispute that first mover advantages can create substantial entry barriers (although they challenge the extent of such barriers)



Application -- Loops

- There is general agreement that most local loops should be unbundled [See, e.g., *Qwest, Farrell Reply Dec.* ¶ 22]
- All local loops – not just all-copper loops -- exhibit classical natural monopoly characteristics, because they have scale and scope economies and are characterized by sunk costs
- In addition, ROW issues may create significant problems, and building access is also very difficult to obtain for fiber loops to serve the largest buildings
 - After many years of trying, AT&T has only been able to build fiber loops to about 10-12% of all buildings that may be suitable for such loops
 - And the vast majority of those loops can only be used to serve specific customers



Application -- NGDLC Loops

- Competitive carriers need access to local loops in order to “offer both voice and broadband services” [*Verizon, Kahn-Tardiff Reply Dec.* ¶ 39]
- NGDLC loops are just another type of loop. Access to the copper *subloop* portion of NGDLC loops is not a viable substitute for access to the entire unified loop
- Accessing traffic at a remote terminal or serving area interface would be uneconomic for competitive carriers, requiring them to bear costs that are often comparable to collocating at a central office, but only allowing them to serve a fraction of the customers they could reach at the central office
- CLECs must also incur the additional cost of routing traffic from the remote location back to its network, losing access to the ILEC’s scale economies on the facilities between the remote location and the ILEC central office



Application -- Transport

- ILEC economists recognize that transport facilities, like loops, exhibit substantial scale economies and sunk costs [See, e.g., *Qwest, Farrell Reply Dec.* ¶ 28]
- ILEC economists also agree that the relevant market for supply of transport is local and point-to-point [See, e.g., *SBC Shelanski Dec.* ¶ 22; *Qwest Farrell Reply Dec.* ¶ 29]
- Three important points flow directly from these observations:
 1. Impairment decisions cannot be based on the presence of specific equipment or facilities at only one end of a route
 2. CLECs must have substantial traffic volumes in order to deploy the same high capacity facilities as the ILECs and achieve the same economies of scale
 3. The localized nature of a competitor's need for transport facilities precludes any attempt to conclude there is a general lack of impairment, even if there are a handful of specific instances in which there may be a sufficient competitive supply of transport



Application -- Switching

- Existing manual hot cut processes provide CLECs inferior access to voice-grade loops, both in terms of cost and quality of service
 - Until existing manual processes are replaced with some form of electronic loop provisioning, CLECs will be impaired without access to unbundled switching to serve voice-grade loops
- CLECs also lack the ILECs' dense, geographically concentrated customer base. Thus, they must also incur substantial "backhaul" costs for collocation, transmission equipment and transport facilities that the ILEC does not have to incur when self-deploying switching



ILEC Counter-Arguments Lack Economic Support

- **Access Services Are Not A Substitute For UNEs**
- ILECs assert that CLECs can use “access services” to acquire customers and mitigate sunk cost and first mover disadvantages. But
 - The ILECs do not offer access services that correspond to the UNE-P or voice grade loops.
 - The ILECs’ access services are priced at twice TELRIC.
 - CLECs cannot offer effective competition if their costs are well in excess of the ILECs’

The bottom line: Access services cannot substitute for UNEs unless they are available at costs comparable to TELRIC and provide the same network functionalities as UNEs, including the UNE-Platform



ILEC Counter-Arguments Lack Economic Support

- **Operational Barriers Must Be Actually Overcome**

- ILECs claim that real world “operational” barriers should be dealt with “directly” instead of treating them as impairments
- But from an economic perspective, those impairments are real until they are actually eliminated

- **First Mover Barriers Cannot Be Easily Overcome**

- ILECs claim that their first mover advantages can be overcome, but
 - Municipalities generally see little benefit in extending ROWs to second-mover CLECs; as a result, CLECs still find it harder to construct facilities than ILECs
 - Landlords force CLECs to accept more limited and costly terms for access to their buildings
 - ILEC “fault” with respect to these real economic disadvantages is irrelevant

- **“Greenfield” Situations Occur Very Rarely**

- The ILECs enjoy an enormous advantage in “new” construction because their existing networks are ubiquitous, have substantial excess capacity, are designed to be easily expanded and they typically have ubiquitous ROWs
- Unless “new” construction does not enable the ILEC to rely on any of these conditions, a new entrant faces significant disadvantages



Use And Co-mingling Restrictions Impede Local Competition

- Existing use and co-mingling restrictions prevent CLECs from using loop-transport combination UNEs to assemble efficient networks
- Such restrictions force CLECs to rely on ILECs' high-priced access services, which are priced well-above TELRIC and thus create significant cost disadvantages
- CLECs need access to loop-transport combination UNEs in order to acquire customers and mitigate sunk cost and second mover disadvantages; otherwise their ability to build additional facilities is significantly reduced



Clarke TR Reply Comments declaration on: **CLEC investment incentives**

- ⌘ Hard to collect CLEC local network facilities investment data that are consistent across CLECs
- ⌘ Used internal state-by-state data on AT&T's own local facilities deployment and its use of local facilities leased from the ILECs
- ⌘ *Dependent variables*
 - ☒ Number of AT&T local switches in a state
 - ☒ Number of DS1 line terminations on these AT&T local switches
 - ☒ Number of AT&T local fiber route-miles
 - ☒ Normalized by state population (or other controls)
- ⌘ *Independent variable*
 - ☒ AT&T's budgeted expenditures for leased local connectivity
 - ☒ All payments made by AT&T to ILECs for leased local facilities
 - ☒ Includes both UNEs and special access purchased for local connectivity
 - ☒ Normalized by state population and other controls, e.g., UNE-P price index

Results

- ⌘ Coefficient on AT&T's budgeted expenditures for leased local connectivity is always positive and highly statistically significant
 - ☒ The more AT&T leases ILEC local network facilities in a state, the more of its own local network facilities it deploys
 - ☒ Best fit is for number of switch terminations and number of switches (coefficient significance > 99.9%, Adjusted $R^2 \sim 0.6$)
 - ☒ Local fiber miles fit is less precise (coefficient significance > 95%, Adjusted $R^2 \sim 0.2$) – likely because of inadequate control for variability in lines densities across states
- ⌘ These results demonstrate that less leased facility availability will not induce more CLEC facilities deployment